

Automatic Trim for Power Boats

Cross Reference to Related Application

This is a continuation-in-part of U.S. patent application No. 10/370,965 filed on February 20, 2003.

5 Technical Field

This invention relates to providing additional trim to a power boat at low speed, thereby to lift the stern and obtain plane more quickly, the trim being automatically effected by the power trim of the drive, such as the motor or outdrive.

10 Background Art

It is well known that when a power boat accelerates from a standstill, the nose goes high and the stern goes low until a certain speed is obtained, which typically is between 20 and 30 miles per hour. Then the boat levels off and is said to be on plane. It is for
15 this reason that transoms tilt so as to be closer to the bow below the water line, thereby to provide some upward thrust on the stern during acceleration. Modern bass boats and ski boats have power trim which allows the operator to move the propeller aft once plane has been attained, thereby to keep the bow of the boat from
20 plowing, and reduce drag, so that higher speeds may be attained and less effort of the motor is required to achieve any given speed. Trim tabs have been provided at the aftmost extreme of the hull, extending downwardly somewhat from the bottom of the hull. Static trim plates however remain in place at higher speeds and thereby
25 produce significant drag, which reduces speed and wastes fuel. Adjustable trim tabs are complex and require electric or hydraulic

mechanisms together with operator controls and communication between the mechanisms and the controls.

Disclosure of Invention

5 Objects of the invention include: providing low speed upward trim automatically in response to the position of the drive; trimming which is responsive to the power trim of the boat's drive; using the power trim of the boat drive to create additional trim providing lift to the stern of the boat at low speeds, and providing no drag at all at higher speeds.

10 According to the present invention, the stern of the boat is lifted during acceleration at very low speeds by means of at least one trim tab which is moved downwardly into a full lift position by the boat's drive when in the lowest trim position, and which is rapidly raised to a position where it is out of the water, thereby providing
15 absolutely no drag, in response to a small amount of trim imparted to the boat's drive. By being coupled to the boat's drive, the stern-lifting trim tabs of the invention are automatically in place when desired, and out of the way when trim is not desired. The invention is readily adapted to a wide variety of inboard/outdrive and outboard
20 boats and hulls.

 According to the invention still further, one embodiment of the invention, useful with an outboard motor which is extended from the transom by a jack plate, has a push tube that provides free play of the engine at higher trim positions, but engages a push rod at
25 lower trim positions, the push rod being connected with at least one trim tab so that as the motor reaches the lowest positions of trim, the push tube engages the push rod and causes the trim tab to be lowered into the water, below the fair line of the hull bottom.

According to the invention in another form, which is suitable for use with outboard motors mounted directly to a transom and with inboard/outdrive packages, a horizontal push bar pushes on linkage that operates the trim plate only when the boat's drive, that is the vertical portion of the power train that transfers torque to the propeller, is in the lowest trim positions. In the highest trim positions, free play is obtained because the drive does not engage the horizontal push bar.

Another embodiment of the invention includes a master cylinder engaged by the drive when the drive is reaching its lowest trim positions, the master cylinder being connected by tubing to one or more slave cylinders connected to at least one trim tab. Although hydraulic fluid is preferred, this embodiment may be pneumatic, if desired.

Yet another embodiment uses a position detector to provide an electrical signal indicative of the position of the drive, whenever the drive is sufficiently low so as to engage the trim tabs. The position signal is utilized to operate a pump which operates an hydraulic actuator to move the trim tab proportionately with the position of the drive. This embodiment may be practiced on boats already having hydraulic trim which is, however, manually controlled, by substituting a position sensor and other appropriate electronics for the manual controls.

In another embodiment, a power transmission cable, such as a throttle cable, is utilized with linkages to transmit the engine position mechanically to operate the trim tab, once it is at the point of engagement.

Although the first two embodiments find their greatest utilization in situations in which the drive does not achieve various

vertical or horizontal positions with respect to the hull of the boat, the last mentioned three embodiments are useful in manually or hydraulically adjustable jack plates, and in other situations where position of the drive with respect to the boat (other than its trim position) may vary.

5 The invention may be implemented utilizing rack and pinions, jack screws, stepper motors, or other actuators to move the trim tab. The actuators may respond to a variety of drive position sensors, such as linear variable differential transformers (LVDTs),
10 potentiometers, with rack and pinion or other gearing where appropriate, and in the simplest of cases, a switch which causes the trim tabs to be moved to the fully downward position as soon as the switch is engaged, and causes the trim tabs to remain in that position until the switch is released. This is achievable, for instance, utilizing
15 fluidic pressure in a hydraulic or pneumatic cylinder connected to the trim tabs.

 The invention obviously can be utilized with one trim tab or several trim tabs, with one or more actuators on each trim tab.

 The invention provides significant stern lift at lowest speeds, but provides no drag at medium and upper drive trim positions, all of
20 the motion of the trim tab being controlled by the boat's drive in response to the power trim already installed with the boat drive.

 Other objects, features and advantages of the present invention will become more apparent in the light of the following
25 detailed description of exemplary embodiments thereof, as illustrated in the accompanying drawing.

Brief Description of the Drawings

Fig. 1 is a side elevation view of an outboard motor mounted on a jack plate with one embodiment of the invention installed, when the drive and the trim tab are all the way down.

5 Fig. 2 is a view as in Fig. 1 with the drive and the trim tab partially up.

Fig. 3 is a view as in Fig. 2 with the trim tab fully up and the drive at about a mid-trim position.

10 Fig. 4 is a view as in Fig. 1 with the trim tab fully up and the drive in nearly the full trim position.

Fig. 5 is a partial, partially sectioned, side elevation taken on the line B-B in Fig. 6, with the trim plate in the position shown in Fig. 3.

15 Fig. 6 is a partial, partially sectioned, top plan view taken on the line A-A of Fig. 5, with the template in the position shown in Fig. 2.

Fig. 7 is a side elevation view of an alternative embodiment of the invention, using a push rod.

Fig. 8 is a partial top plan view of the embodiment of Fig. 7.

20 Fig. 9 is a partial, partially sectioned, side elevation view of a passive hydraulic embodiment of the invention.

Fig. 10 is a side elevation view of an embodiment of the invention using an electrical position detector to operate a hydraulic actuator.

25 Fig. 11 is a side elevation view of an embodiment of the invention utilizing a force transmitting cable and linkages to cause the trim position of the drive to operate the trim tab.

Mode(s) for Carrying Out the Invention

Referring to Fig. 1, a boat 10 has a jack plate 11 (or motor mount), mounted to the transom 12 of the boat. The transom bracket 15 of a propulsion system, such as an engine 16 is mounted to the jack plate 11, all in a known fashion. The engine has a propeller 17. A trim plate 18 is rotatably disposed at the base of the transom by means of a piano or other suitable hinge (19, Fig. 5) so that the trim plate can rotate upwardly and downwardly in response to different trim positions of the motor 16, as illustrated in Figs. 1-4.

In Fig. 1, the motor is in its lowermost, untrimmed position, and the trim plate 18 extends below the fair line of the hull. As the motor is trimmed a little bit, illustrated in Fig. 2, the trim plate 18 rotates upwardly to about a mid point. As the motor trim is increased, as illustrated in Fig. 3, the trim plate 18 rotates into a fully upward position, where it is out of the water and has absolutely no effect. As the trim of the motor is increased further, as illustrated in Fig. 4, due to a lost-motion effect described with respect to Fig. 5 hereinafter, the trim plate remains in its fully upward position, independently of further upward trim of the engine 16.

Referring to Figs. 5 and 6, the trim plate 18 has a clevis 21 attached thereto by means of flat head machine screws (not shown) and nuts 22. A pintle bolt 23 rotatably secures a tongue 24 to which is threaded a rod 25. The rod 25 is also threaded into a tongue 28 which is pivoted by a pintle bolt 29 to a clevis 30. As seen in Fig. 6, the clevis 30 is formed of two pieces 33, 34 which have upwardly extending tabs 35, 36 that form another clevis 37. The pieces 35, 36 are bolted to corresponding tabs 40, 41 of a bracket 42 by bolts 43, 44. The pieces 33, 34 are free to rotate upwardly and downwardly about the bolts 43, 44. A pintle bolt 47

secures a tongue 48 into which is fixed a threaded push rod 49 having a pair of nuts 50, 51 tightened thereon. The push rod 49 is surrounded at its upper end by a push tube 54 which is free to slide up and down on the push rod 49, above the nut 51. The push tube
5 54 is fastened to a tongue 55 that is engaged by a pintle bolt 56 within a clevis 57 which is anchored to the engine drive 58, just aft of the tilt tube 60, by means such as machine screws 61.

As the motor is trimmed in the various positions shown in Figs. 2-4, the push tube 54 will be raised and lowered
10 commensurately. So long as the motor has sufficient trim that the tilt tube does not touch the top of the nut 51, the trim plate 18 will be unaffected. But when the trim is lowered sufficiently, the push tube reaches the pick up point which is when it contacts the top of the nut 51, beginning to rotate the clevis 30 downwardly, thereby
15 pushing downwardly on the trim plate through the rod 25.

The pick-up point (the point at which the trim plate 18 will begin to be lowered) is determined by the setting of the nuts 51, 50; if the nuts are higher, the engagement is at a higher trim position, and if the nuts are lower, the engagement is at a lower trim position.
20 The lengths of the push tube 54 and push rod 49 should be sufficient so as to not disengage by virtue of the trim tab rising, when the boat is backing up with the motor trim down, due to force of water against the trim tab.

The amount of trim tab motion, or the trim tab position, as a
25 function of motor motion, or motor position, can be adjusted by placement of the pintle bolt 29 in different positions established by a plurality of holes 64 in the pieces 33, 34. As shown in Figs. 5 and 6, a relatively small amount of engine motion will provide the full range of trim tab motion. In Fig. 5, the hinge 19 is shown as it may

be connected to a cross strap 65 which may be part of a jack plate, or which may be added to the standard jack plate structure. In this case, the cross plate 65 is fastened, such as by machine screws (not shown) to a bracket 66 that is bolted to the jack plate 11 by means of bolts 67, 68. The use of the bracket 66 allows positioning the trim tab 18 at the very base of the transom, well below the extent of a typical jack plate.

The upper position of the trim tab 18 is defined by the bottom of the bracket 66, as shown in Fig. 5. The trim plate 18 is urged upwardly by means of a spring 71, the lower loop 72 of which extends between a pair of holes 73, 74 (Fig. 6). An upper loop 75 of the spring 71 is secured by a lock nut 76 on a bolt 77 which extends through the far wall of the jack plate 11. Additional holes, such as a hole 79 (Fig. 6) may be provided to allow adjustment of the spring tension, and the direction of force provided by the spring.

In Figs. 5 and 6, the jack plate is simulated and does not represent any particular known jack plate. The bracket 42 is shown fastened, such as by a machine screw and nut 82 to an angle iron 83 (not shown in Fig. 6 for clarity) which may extend across the jack plate. However, the bracket 42 may, in a typical case, be fastened directly to some part of the engine itself, such as the zinc plate, or other structure on the drive.

The trim tab 18 is shown to have a proximal portion 84 which is connected to the hinge 19 and a distal portion 85 which is at an angle to the proximal portion 84. On the other hand, the trim tab 18 may be rounded instead of having a distinct angle, or it may simply be a straight piece. The shape of the trim tab is irrelevant to the present invention, so long as it can be moved from a position providing significant lift to a position where it has no effect

whatsoever in an adequately small range of motor trim adjustment. Although only the spring 71 is shown on the port side of the boat, a similar spring would be similarly disposed on the starboard side of the boat. In Fig. 6, the trim tab 18 is shown with a notch 86 in the aft edge thereof, which might be useful in some installations to provide adequate clearance to the fairwater of the lower drive of the engine. On the other hand, no notch 86 need be provided if not useful in any given case.

Two separate trim tabs may be controlled by separate rods 25 if the pintle nut is extended to opposite sides of the drive, or by separate rods 25 and clevises 30 by extending the pintle bolt 47 to opposite sides of the drive.

The present invention is disposed within the space provided by a jack plate. The typical jack plate has a fore-and-aft dimension of at least a couple of inches within which the apparatus of Figs. 5 and 6 can easily be disposed. A jack plate also provides space for the trim tab between the lowest part of the transom and the engine, as is seen in Fig. 5. For outboard motors fitted to a transom directly, without a jack plate, and for inboard/outboard drives, a different sort of mechanism may be used. In such a case, two separate trim tabs, one on each side of the engine may be used, using a push bar between the engine drive and the transom to operate the mechanism, the engine not being connected thereto and free to turn in any direction at any trim position.

Another embodiment of the invention is illustrated in Figs. 7 and 8. In Fig. 8, and depicted in solid lines in Fig. 7, a drive of, for instance, an inboard/outboard (outdrive) system is depicted at a pickup point, that is, the point where reducing the trim of the drive will actuate the mechanism to lower the trim tab. In Fig. 7, the drive

is represented at the pickup point by a solid line 91, and is represented at a position where the trim tab 18a is completely lowered, by a dash line 92. In Fig. 8, the aftmost tip of the drive 58 is equivalent to the line 91 in Fig. 7. To provide clearance for the drive, which is very close to the transom in an inboard/outboard system, two separate trim tabs are used, only the port trim tab 18a being illustrated in Figs. 7 and 8.

The mechanism is operated by a push bar 96 which may have an inner steel rod 97 and a hard, lubricating plastic outer tube 98, such as TEFLON® or DELRIN®, or other suitable plastic. The ends of the rod 97 may be secured with a nut 100. A shoulder 101 may be provided to assist in separating a pair of generally L-shaped members 104, 105. The members 104, 105 are rotatably attached to a tongue 107 by a pintle bolt 108 secured by a nut 109. Between the other ends of the pieces 104, 105 a tongue 112 is rotatably secured by a pintle bolt 113. The tongue 112 is threaded to a rod 115, the other end of which is threaded to a tongue 116 which is rotatably secured to a clevis 117 by a pintle bolt 118. The clevis 117 is secured to the trim tab 18a by any suitable means such as a pair of short machine screws 120. The spring 71 (shown only in Fig. 8 for clarity) may be secured to an ordinary eye 125.

Referring to Fig. 7, when the drive 58 is moved from the pickup point denoted by the solid line 91 to its lowermost trim position, denoted by the dash line 92, the pieces 104, 105 will rotate clockwise so that the mechanism and the trim tab assume the positions illustrated by the dotted lines in Fig. 7.

The embodiment of Figs. 7 and 8 is suited to an inboard/outboard drive which, in its lowest trim position, is very close to the transom. The same mechanism may be used with an outboard

motor in the absence of a jack plate, although provision may be made to accommodate the fact that the outboard motor is farther away from the transom, due to the transom bracket 123 (Fig. 1).

5 The pieces 104, 105 may be provided with several different holes to make it easy to adjust the mechanism for the desired relationship between the trim position of the drive and the position of the trim tabs 18a.

10 In some cases, the embodiment of Figs. 5 and 6 may be modified in various ways so as to connect the trim tab operating mechanism directly to an outboard motor without a jack plate or directly to an inboard/outboard drive. One way to achieve this is to provide two sets of the embodiment of Figs. 5 and 6, they however being rotated 90° so as to take up little fore and aft space but instead to be athwartship. Each mechanism will then operate a
15 separate trim tab, such as the trim tab 18a in Fig. 8. In such a case, the pieces 33, 34 would likely be straight (similar to the pieces 204, 105 in Figs. 7 and 8) and disposed to rotate in planes generally parallel to the transom. All of this should be well within the skill of the art in view of the teachings hereinbefore.

20 Referring now to Fig. 9, an adjustable jack plate 11a has one portion 11b attached to the transom of a boat as described hereinbefore, and another portion 11c attached to the motor's transom bracket (123, Fig. 1). Pins 130 on the portion 11c slide in slots 131 on the portion 11b. The portion 11c is shown near its
25 lowest position, and may be raised so as to raise the position of the motor relative to the hull, either manually or by means of hydraulic actuators, all of which is conventional, forms no part of the invention, and is not described further.

In Fig. 9, a master cylinder 134 is anchored to the portion 11c, such as by means of a bracket 135. The piston of the master cylinder 134 is connected by a rod 137 to a button 138 that is moveable by a knob 57a anchored to the engine drive 58, such as by means of machine screws 61.

The button 138 is shown in a position where the knob 57a has just engaged it; any further downward trim of the motor will cause the rod 137 to be pushed into the master cylinder 134 causing fluid to flow in a drive hose 141, thereby causing a slave cylinder 142 to extend its rod 143 downwardly and push the trim tab 18 into an effective position. As the piston within the slave cylinder 142 is lowered, fluid is vented to the master cylinder 134 through a vent hose 146.

When the motor is raised from its lowest trim position, the spring 71 will raise the trim tab and cause the shaft 143 to advance into the slave cylinder 142 forcing fluid through the drive hose 141 and the vent hose 146 so as to restore the cylinders to their inoperative positions as shown in Fig. 9.

As an example, the master cylinder may have an inner diameter of about two inches, the slave cylinder may have an inner diameter of about three-quarter inch, and in such a case, a movement of the rod 137 of about three-quarters of an inch will cause the rod 143 to move about three inches, which is adequate to position the trim tab 18. Of course, variations in the size and stroke of the cylinders can be made to suit any implementation of the present invention. Also, the point where the slave cylinder is attached to the trim tab may be adjusted so as to provide desired performance.

In Fig. 10, the slave cylinder 142 is driven by a pump 148 on the boat, in response to an amplifier or other electronic signal

conditioning 148a in response to a position signal on a line 149 provided by a position detector 150. The position detector may take a variety of forms, not relevant to the invention, such as a linear variable differential transformer (LVDT), a suitably geared
5 potentiometer, or other position detectors which are known in the art. This embodiment may be utilized on boats already having hydraulic trim which are operated by manual controls, such as a solid state electronic gauge, a time wheel or other control devices. Thus, a boat already having hydraulic trim tabs need only provide the
10 position detector 150 and the suitable electronics 148a in order to take advantage of the present invention.

In Fig. 10, the spring 71 may be eliminated, and the pump 148 utilized to draw the trim plate 18 back into the rest position as shown in Fig. 10.

15 Fig. 11 illustrates an embodiment of the invention utilizing a force transmitting cable assembly 155 having a rigid flexible cable 156 within a sheath 157 which is secured at one end to the jack plate portion 11b by a bracket 160 and is secured at the other end to the jack plate portion 11c by a bracket 161. When the motor is
20 trimmed below the contact point shown in Fig. 11, an arm 164 will rotate counterclockwise about a pivot 165 thus drawing the cable 156 upwardly. This will cause an arm 167 to rotate clockwise about a pivot 168 and cause a rod 169 to push downwardly, thus lowering the trim tab 18 into an operative position.

25 In each of the embodiments herein, there is lost motion; that is, for trim positions of the drive which are higher than the position where the drive makes contact with the mechanism of the invention, as illustrated in Figs. 7 and 9-11, there is no motion of the automatic trim device of the invention. In Fig. 7, the lost motion is between the

tube 54 and the nut 51. However, it is not necessary that this be so, provided the trim tab assumes a position as illustrated in Figs. 5, 7 and 9-11 when the drive is trimmed above the pickup point, which is behind the boat and out of the way, and thereafter is not responsive to trim positions of the drive. Any sort of suitable apparatus may operate the trim tab in response to any compatible sort of signal or motion indicative of the position of the drive.

The invention may be used with outboard motors or inboard/outdrive units having a jet drive instead of a propeller.

Thus, although the invention has been shown and described with respect to exemplary embodiments thereof, it should be understood by those skilled in the art that the foregoing and various other changes, omissions and additions may be made therein and thereto, without departing from the spirit and scope of the invention.

I claim: